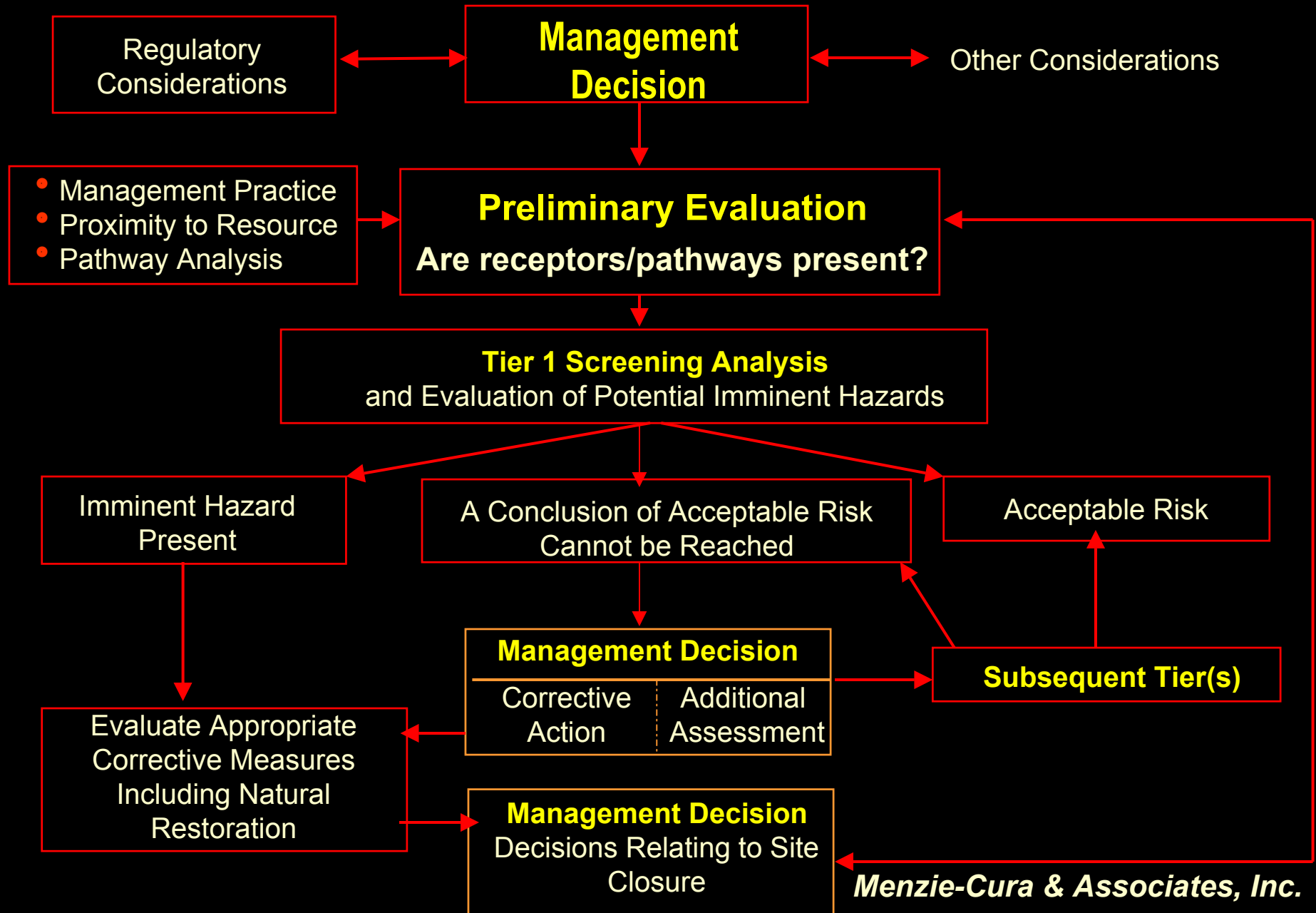


Application of Weight of Evidence Approaches to Sediments



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Tiered Ecological Assessment Process



Common Assessment Endpoints

Sustainability of fish populations
(survival, growth, reproduction)

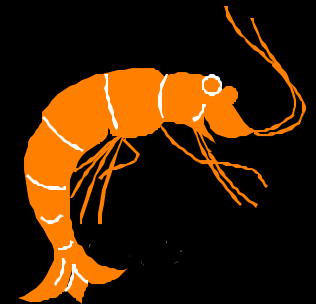


Sustainability of local wildlife populations,
(survival, growth, reproduction)



Sustainability of benthic invertebrates that
serve as a prey base

(note: some times treated as
measurement endpoints)



Applying a Weight-of-Evidence Approach

For each aspect of the ecological risk assessment, the following are considered:

- 1 the level of confidence - or weight - given to the various measures,**
- 2 whether the result of the measurement indicates there is an effect,**
- 3 the strength of the result, and,**
- 4 concurrence among the various measures.**

Note: the sediment triad is an example of a weight-of-evidence approach focused on a sediment invertebrate assessment endpoint.

Criteria for Selecting and Weighing Measurement Endpoints

Relevance of Measurement Endpoints

- i) Biological relationship between the measurement endpoint and assessment endpoint
- ii) Correlation of stressor to response
- iii) Sensitivity of the measurement endpoint for detecting changes in the assessment endpoint
- iv) Utility of the measure for judging environmental harm

Criteria for Selecting and Weighing Measurement Endpoints

Data Quality

- v) Extent to which data quality objectives are met

Study Design and Execution

- vi) Site specificity
- vii) Temporal and spatial representativeness
- viii) Use of a standard protocol
- ix) Sensitivity of the measurement

ASSESSMENT ENDPOINT:
Sustainability of a benthic community that can serve as a prey base

Measurement Endpoint	Tidal River (Pb)	Estuarine Cove (Hg, Organics)	Estuarine Cove (Metals)	Lake (Pb)	Reservoir (Metals)	FW Creek (PCBs, Pesticides)
Chemical measurements of COPCs in sediment (compared to benchmarks and used in predictive toxicity models)	X	X	X	NA	X	NA
Sediment SEM-AVS or (SEM-AVS)/foc	X	X	X	NA	X	
Sediment toxicity testing (inverts)	X	X		NA	X	NA
Benthic community analysis	X	X	X	NA	X	NA
Body burdens of COPCs in invertebrates vs. reference and TRVs		X	X	NA		

ASSESSMENT ENDPOINT:

Sustainability of a Fish Community

Measurement Endpoint	Tidal River (Pb)	Estuarine Cove (Hg, Organics)	Estuarine Cove (Metals)	Lake (Pb)	Reservoir (Metals)	FW Creek (PCBs, Pesticides)
Surface water COPC concentrations vs. benchmarks	X	X	X	X	X	X
Fish species composition and meristics				X	X	
Sed and/or water tox tests (fish)				X	X	
Fish COPC body burdens vs. reference and TRVs	X	X	X	X	X	X
Measures indicating sustainability of benthic invertebrate prey				X		X

ASSESSMENT ENDPOINT: Sustainability of local aquatic wildlife populations

Measurement Endpoint	Tidal River (Pb)	Estuarine Cove (Hg, Organics)	Estuarine Cove (Metals)	Lake (Pb)	Reservoir (Metals)	FW Creek (PCBs, Pesticides)
Observations of wildlife	X		X	X		X
Concentrations of COPCs in sediments	X	X	X	X	X	X
Concentrations of COPCs in surface waters	X			X	X	X
Concentrations of COPCs in aquatic plants	X		X	X	X	X
Concentrations of COPCs in fish	X	X	X	X	X	X
Concentrations of COPCs in invertebrates	X	X	X	X	X	X

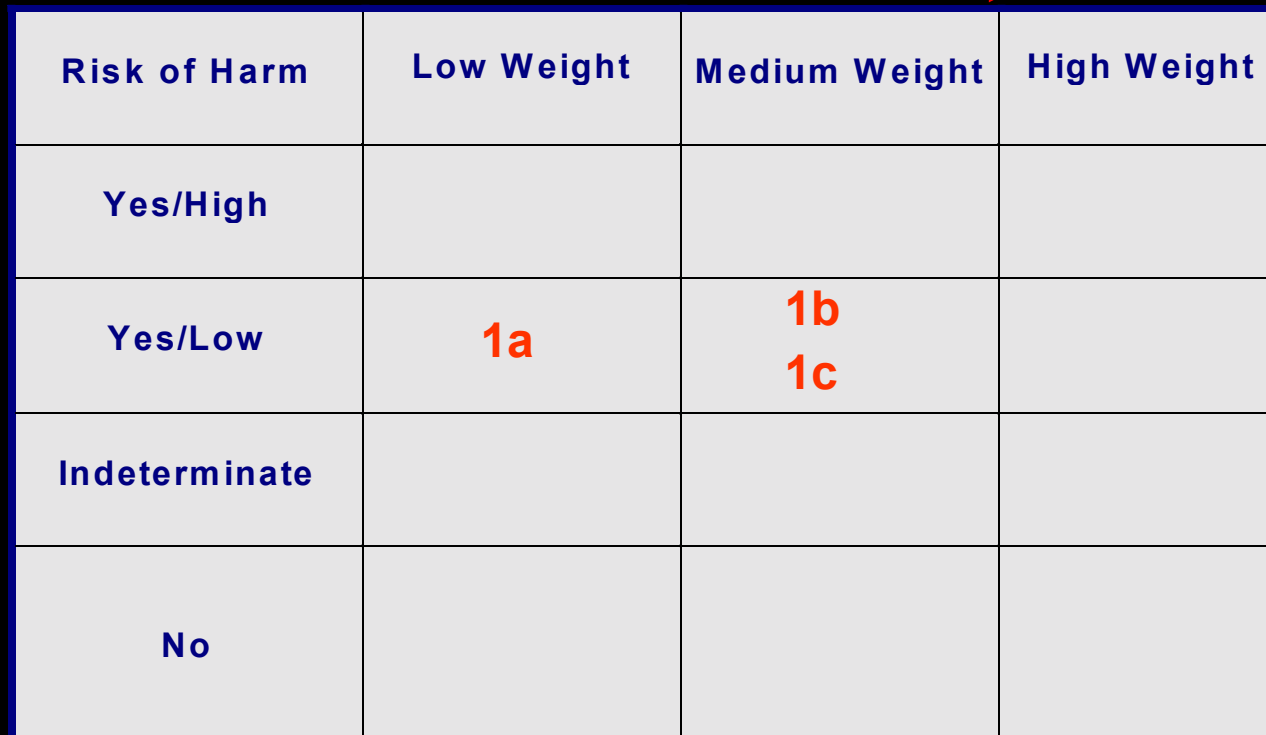
Evaluation and Presentation

- Establish linkage between measurement and assessment endpoints
- Distill evaluations to clear statements of risk of harm

ASSESSMENT ENDPOINT 1: SUSTAINABILITY OF A BENTHIC INVERTEBRATE COMMUNITY

Increasing confidence or weight

Decreasing risk of harm



Risk of Harm	Low Weight	Medium Weight	High Weight
Yes/High			
Yes/Low	1a	1b 1c	
Indeterminate			
No			

1a Chemical measurements and predictive toxicity models

1b Analysis of benthic community structure

1c Sediment toxicity tests

TIDAL RIVER ECOLOGICAL RISK ASSESSMENT

Menzie-Cura & Associates, Inc.

Assessment Endpoint 1		
Sustainability of warm water fish		
Weighing Factors		(Increasing Confidence or Weight)
Low Weight	Medium Weight	High Weight
		1d - Lead exceeds AWQC throughout lake. Chromium, aluminum, and cyanide exceed levels less frequently.
	1e - reduced abundance of amphipods in Lake Waban compared to reference lakes	1a - Growth rates of largemouth bass and yellow perch are lower than in reference lakes.
	1f - Metals in sediments may be available to biota in Lake Waban and Lower Waban Brook (SEM-AVS > 0)	
	1c - Fish are accumulating metals to a higher degree than reference lakes	
	1b - Reduced fish larvae survival for sediment toxicity tests in the laboratory. Little or no survival observed in the field. Results could be due to physical effects.	1g - Due to the difficulty in obtaining sufficient mass for analysis, only one sample of benthic invertebrates was collected.
	1b - Fish larvae survived in water-only toxicity test	1a - Fish community composition and relative abundance similar to reference lakes
		1c - fish are not accumulating metals to levels associated with toxic effects

Lessons learned

- The Process
- The Assessment Endpoints
- The Measurement Endpoints
 - ▶ Chemistry including SEM - AVS
 - ▶ Toxicity Tests
 - ▶ Benthic Invertebrate Studies
 - ▶ Fish Studies
 - ▶ Tissue Residues